

Army FY 2000 Topic Areas

General questions concerning Army participation in the DoD DUS&T program may be posed to Dr. Tom Killion, (703) 601-1535, email: killiont@sarda.army.mil.

Prior to submitting your proposal, contact the Army topic point of contact (TPOC) for a copy of that Agency's current model agreement or other information. Direct specific technical questions and white papers to the specific TPOC identified with each topic.

AFFORDABLE SENSORS

TITLE: Implantable “Passive” Temperature Sensing And Communication Device

OBJECTIVE: Develop a small, low cost, implantable microchip based device requiring no on-board power supply, to determine the temperature inside an object, such as propellant charges, and be able to “read” this temperature remotely, without any hard wire connections between the detection device and associated “reader”.

Delivery accuracy of artillery, tank ammo, and other projectiles to distant targets is dependent upon numerous factors. One particularly important factor that to date has remained problematic, is determining the temperature of the propellant grains inside propellant charges with precision prior to firing. Knowing temperature is important because propellant burn rate, the resulting pressure-time profile, and in turn muzzle exit velocity, is a function of the propellant temperature. A ballistic fire control solution that assumes a muzzle velocity based on nominal propellant performance will introduce delivery error if the true internal temperature (and hence performance characteristics) is not accurately known.

DESCRIPTION: The following elements shall be addressed in the development process: Any device embedded inside a propellant charge must be low in cost, roughly in the vicinity of \$1.00 - \$2.00 per unit or less ideally (for large volume production).

Any embedded device must be very small - rough order of magnitude .35” X .35” X .10”
Temperature ranges of interest are from approximately - 50 degrees F to + 150 degrees F operational, with measurement precision ideally +/- 5 degrees F (or better).

Investigate adding passive humidity and pressure sensing capabilities
The device needs to be chemically stable/compatible with the propellant grain environment. Ideally the device would completely combust during the propellant burning process leaving negligible residue behind and/or present no gun barrel wear accelerating mechanical impacts. The device shall be remotely readable from a distance of at least 8 inches (48+ in. desired) through a non-metallic “container” and through graphite coated propellant grains.

The ability to remotely read and write approximately 32 bytes (or more) of data is needed, and storage of maximum/minimum temperature experienced is desirable.

In the commercial sector there is a wide range of potential applications for this technology. Many products are sensitive to the temperature (and other environmental aspects) of their storage and transportation environment. These products include such things as fresh produce, industrial chemicals, medical supplies, sensitive electronics, etc. With this technology, one could quickly “scan” products to determine if critical temperature thresholds have been breached as well as determine the current temperature for example. This would apply to the *internal contents* of packaged items without the need to open packages. Since the device will be low in cost, the economic viability of its use will apply to an especially large range of products including those of modest cost. If the device is “passive” and

powered solely by incident radio frequency energy, there will be no battery to “die” and the device would be long lived, suitable for continued re-use. The technology could also be utilized as a process control element generating feedback information to optimize numerous production processes for which temperature control is an important parameter.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$800K

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SUBMIT PROPOSALS TO:

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TITLE: Interference Indication and Detection System

OBJECTIVE: The objective of this dual use effort is to provide tactical radio indication and detection capability against QRN/QRM interference and multipath. A design, development and integration of a simple low cost technique for the detection of interference, jamming and multipath signals shall be demonstrated. Software algorithms for the automatic indication of the presence of interference, jamming and multipath signals shall be implemented

DESCRIPTION: SINCGARS and EPLRS radios provide a limited capability to detect the presence of QRN/QRM signals and jamming signals disrupt the flow of voice and data communications in the digital battlefield. The digital networks integrated with tactical radios in the Army Tactical Internet will provide the individual warfighter with an information advantage by providing real time situation awareness and C2 data throughout the battlefield. This information is timely and critical to tactical operations. The need to detect and provide an automated indication of surgical or barrage jamming intended to electronically attack critical nodes of the C2 architecture is critical to the operation of these systems. Recent field tests have demonstrated the need to provide the capability to detect the presence of jamming on the tactical battlefield. Individual warfighters currently cannot distinguish between jamming, interference and specific attacks against the applique computer system during normal operations. The integration of simple methods for the detection of jamming and the automatic indication of the presence of interference signals will provide the warfighter with the capability to take proper preventative measures to mitigate the effects. The integration of software or simple hardware modifications to legacy radios shall be developed, integrated and demonstrated. Software algorithms shall be developed for developmental systems. Hardware and software developed shall be provided to PMs with recommendations for implementing into legacy systems. Performance of the existing legacy system shall not be degraded by the implementation of the hardware and software modification. A low cost approach (preferably a software only modification) shall be used to address the implementation of this capability into legacy systems.

Commercial Application: Wireless telecommunications systems can be provided the capability to detect the presence of interference signals, detection of multipath signals and the detection of unintentional self jamming in radio and cellular systems. The software tools developed under this effort will be capable of being integrated into commercial systems operating in a dense signal environment.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$200K

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SUBMIT PROPOSALS TO:

U.S. Army Communications and Electronics Command
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TITLE: Low Cost Microsensors and Applications

OBJECTIVE: Develop low cost microsensors in the near and far infrared that are expendable, integrate into multiple attended and unattended applications, and develop commercial spin-off products that will enhance the production quantities to allow for low cost objectives. Miniature size, weight and power are also a top priority so that these sensors could be used in new applications where previous sensors failed to meet the micro sensor definition.

DESCRIPTION: Several applications are contemplated. One application is a helmet-integrated sensor (60 degree field of view or larger). A 1-2 micron (overcast starlight capability), and an 8-12 micron uncooled sensor will be mounted atop a military helmet. A head-mounted display will also be incorporated into the helmet and will display either a single band image or a fused image. The total weight of the sensor and display shall be less than one pound and the total power shall be less than two watts. A transmitter, micro laser rangefinder, battery, and a GPS receiver shall be belt mounted. The commercial counterpart of this is a firefighters helmet with an infrared sensor (8-12 micron) or a portable medical imaging device that could be used as a diagnostic adjunct or to enhance surgical vision. The firefighter version shall be designed to withstand temperatures as high as 400F. The commercial version shall cost less than \$1000 in large quantities. A second application is the micro UAV. An IR uncooled 8-12 micron sensor, GPS, transmitter, acoustic sensor, micro laser rangefinder, and a 1-2.55 (overcast starlight capability) micron sensor would be mounted in a UAV. Such a UAV may be tube launched (such as TOW missile launcher) and have a range of at least 10 kilometers and an altitude of at least 300 meters. The UAV would contain a parafoil to reduce the power requirements. The sensor should be able to recognize a man at 500 meters. All ideas for reduced power management size, weight, and audible noise shall be considered and will be a top priority. Another UAV application could be a miniaturized helicopter. This helicopter would contain the same type of sensors as the tube launched air vehicle. Direction of flight, azimuth and down angle of camera, and GPS position shall be provided to precisely locate a point on the ground for targeting purposes.

In the military mode the cost versus mission value of the sensors should approach "throw-away" status, however the sensors should be recoverable and reissued when possible. In the civilian use mode, alternative air vehicles could be used. Also the configuration of the platform will automatically ensure its safety, even with loss of power. The offeror shall provide a trade-off analysis of imaging performance at varying ranges and altitudes, size, weight, power, and impact on platform vulnerability. A third application is the guarding of mine fields. A set of unattended micro sensors in the far IR (8-12 microns) will cover the perimeter of a minefield and transmit back images of any intrusions. The sensors will have a man ID range of at least 300 meters and be linked together. Power management shall be the utmost of importance so that these sensors can last for over 6 months without attention. All power sources shall be considered with the largest watt-hour per pound being the highest priority. Other

applications include guarding borders (civilian), military installations, nuclear facilities, airports, etc. and as a non line of sight sensor network in the battlefield for the individual soldier. Low cost shall be a very high priority for this application.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$20,000K

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TITLE: Low Cost, Small Form Factor, Environmental Data Sensing, Logging, and Communication Device

OBJECTIVE: Develop a very low cost, highly integrated device to accurately sense ambient temperature, pressure, humidity, 3-axis shock, and possibly chemical species associated with propellant degradation. Data shall be logged for a period as long as ten years without replacement of the on-board power source. “Out of bounds” conditions shall be remotely programmable, and data that falls outside of the normal ranges shall be “flagged” as such. Data logs shall be remotely retrievable from a distance of at least 100 feet from an associated interrogator, which shall also be developed.

Many highly sophisticated weapon systems/missiles are known to be susceptible to environmental extremes that occur on the battlefield as well as during storage and transport. A small, low cost device that could be made part of the system, or attached thereto, to continuously monitor the environment would enable ready diagnoses regarding the “health status” of the system and viability for use. It could also be used to enforce manufacturer warranties. Lack of this information cost the US Army many millions of dollars in missile losses in Operation Desert Storm.

In the commercial sector, this device would be very useful for monitoring the storage and transportation environments of many products, such as electronics, medical supplies, pharmaceuticals, industrial chemicals, produce, meat, etc.

DESCRIPTION: Proposals should address the following areas:

Small form factor – ideally approximately 2 – 3 cubic inches including power source
Integration of multiple Micro-Electro Mechanical Sensor (MEMS) devices

Minimal power consumption – remotely programmable variable time sampling and built in intelligent data sampling. For example, if the system notices that temperature is not changing at say, 10 minute sample intervals, the system may dynamically adjust the sampling interval to 30 minutes, or longer.

- Ten year power source life
- Low unit cost in production – target cost approximately \$20 - \$50/unit
- The device and its associated reader/interrogator device shall be compliant with FCC Part 15 for unlicensed use.
- The device shall be suitable for long term exposure to outdoor weather conditions

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$1800K

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TITLE: Radio Location Sensor

OBJECTIVE: The focus of this effort is to develop a radio external sensing system to detect, identify and geo-locate tactical radio and commercial signals. Traditional intelligence and electronic warfare stand-off systems do not provide real-time information to the individual warfighter. This radio location system would provide the individual warfighters with this information. This radio location system would provide the individual warfighters with this information. The developed system would make use of existing radios or other existing systems. The system shall be designed to be utilized as a man portable, tactical vehicle mounted or airborne system; computer controlled and not require specialized operator training to perform the designated mission. The system shall also be able to acquire RF location data while in a non-stationary scenario as well as in a stationary position.

This radio/location sensor would be capable of being used with a combination others on different platforms to perform precision location of emitters. As technology matures, software programmable technology and Field Programmable Gate Array technology would be used.

DESCRIPTION: This work would provide the tactical commander with wide-area, detecting and alerting capability through enemy radio emissions. This would also provide the tactical commander with situational awareness of the RF environment as well as help reduce fratricide. Existing combat-net-radios (i.e. SINCGARS) would initially be modified to incorporate this technology. The existing radio would be modified to allow the operator to communicate while simultaneously looking through, detecting, intercepting, and identifying other signals. Intercepted signals would be processed to determine signal externals such as frequency, modulation scheme, hop-rate, etc. The waveform characteristics would be cross-referenced to an on-board signal library to determine if “friend or foe”. This radio/location sensor would be capable of being used with a combination of other radio/location sensors on different platforms to perform precision location of emitters. This technology will have widespread commercial applications for search and rescue missions. The technology can be used to geo-locate radios located on distressed boats, cars, and planes as well as individual 911 callers, and the people with medical pagers.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$400K

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ADVANCED PROPULSION, POWER, AND FUEL EFFICIENCY

TITLE: Alternative Fuels

OBJECTIVE: The U.S. Army plans to reduce battlefield fuel consumption 75% by the year 2020. This will make combat units easier to resupply, supply lines easier to protect, and increase the operational and strategic mobility of U.S. forces.

Army policy now dictates JP-8 as the single fuel on the battlefield. This policy simplifies fuel logistics, and permits refueling helicopters in the forward battle area. Diesel and gas turbine engines that are normally fueled with commercial diesel fuels can burn JP-8. JP-8 also provides fire resistance comparable to diesel fuel. Diesel fuel's fire resistance and the fuel economy of diesel engines are the factors that originally led the Army to adopt a diesel-powered ground vehicle fleet.

In 2020, the Army will continue to need a ground vehicle fuel with fire resistance, high stored energy density, and the capability to refuel helicopters and other aircraft in the battle area.

The future Army must reduce its vehicle exhaust emissions during peacetime. The Army owns a large number of vehicles equipped with non-emission controlled diesel engines, and will still own a significant number of these engines in 2020. The most practical means to reduce emissions from these engines may be to use a cleaner-burning substitute for conventional diesel fuel.

By 2010, fuel cell engines may begin to replace diesel engines in commercial use. Fuel cells fundamentally use hydrogen for fuel. Hydrogen is not a practical battlefield fuel because its stored energy density is too low. Methanol and gasoline are possible commercial liquid fuels for fuel cells, because they can be reformed into hydrogen, but their low energy density and flammability respectively make them unusable for the battlefield. Diesel fuel is not currently a favored fuel for fuel cells, because sulfur impurities and large molecules make it difficult to reform. Therefore, the preferred future Army fuel will have improved fire resistance, be reformable, be safe, improved handling and storage properties, improved environmental properties and be available from U.S. domestic feedstock.

DESCRIPTION: Proposal are sought for projects that will develop and demonstrate alternative military fuels to meet the following objectives:

- Have fire resistance equal or better than current diesel fuel,
- Improve exhaust emissions in existing Army-owned diesel engines,
- Be easily reformable for use in fuel cell engines,
- Be a safe substitute for JP-8 in operating aircraft,
- Have physical and storage properties that make it suitable for handling by the Army's current and planned fuel logistics systems.
- Be producible from U.S. domestic feedstocks.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$10,000K

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TOPIC: Fuel Efficiency/Alternate Propulsion Systems

OBJECTIVE: Dramatically improve commercial and military truck fuel efficiency, emissions, mobility and propulsion system lifecycle costs. Improvements in safety, reliability, ease of maintenance, service life, and vehicle lifecycle costs are desirable. The U.S. Army's Army After Next (AAN) concept calls for a 75% reduction in battlefield petroleum usage, as part of overall goals to make the Army's future logistic operations and infrastructure lighter, less costly, more flexible, and less susceptible to interruption or attack. Reduced petroleum usage is potentially the most significant goal because fuel constitutes 70% of the bulk tonnage supplied to military forces. Improved fuel economy will reduce the Army's peacetime operating costs. Highly efficient propulsion systems will make large improvements in military truck fuel economy. More improvements are possible through truck structural weight reductions and streamlining. Automated navigation, mission planning, and cargo inventory tools will improve fuel economy by allowing supplies to be delivered with fewer miles driven.

Emerging commercial advancements in propulsion technologies are expected greatly improve vehicle fuel efficiency. The likely technologies are advanced, low heat rejection diesel engines and improved, electronically controlled mechanical transmissions; hybrid electric drive systems, equipped with optimized electrical systems, including "smart" battery management systems, advanced drive motor designs and motor controllers; and diesel fueled, fuel cell power systems. Army ground vehicles may continue to use commercial diesel and JP8 fuels as their primary fuels for many years. However, commercial shifts toward clean diesel fuels, and fuel cells may eventually lead to adopting "designer" diesel fuels that can also be used in reformer-equipped fuel cell engines.

The AAN's reduced logistic infrastructure will require a more efficient use of maintenance labor. Improved propulsion system diagnostics and prognostics, automated fleet management record keeping, electronic maintenance manuals and other automated maintenance aids are potential means to ease propulsion system maintenance requirements. Initiatives in this area are expected to take advantage of vehicle data bus architectures, such as the SAE 1939 standard.

DESCRIPTION: Develop and demonstrate technologies or design concepts that improve commercial and military truck fuel efficiency, emissions, mobility and propulsion system lifecycle cost of ownership. Benefits in safety, reliability, ease of maintenance, service life, and vehicle lifecycle costs are desirable. Proposals must apply to both commercial and military trucks, and proposals that benefit multiple areas are preferred. Proposals may apply to current, emerging and future truck designs. Estimated benefits of proposals should be based on systems-level consideration of truck designs.

Systems design approaches, when applied across vehicle subsystems, often yield significant benefits in vehicle design. Examples are to design the fuel, emissions controls

and engine as a single system, or to consider how a smart suspension system could reduce truck structural requirements and rolling resistance.

Preferred proposals will include plans for computer modeling to quantify the overall benefits. Modeling approaches should be structured to promote use of the model as a module in a widely-available higher-level vehicle simulation architecture, in support of the Simulation-Based Acquisition (SBA) Initiative (for reference).

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$10,000K

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INFORMATION AND COMMUNICATIONS SYSTEMS

TOPIC: C2 Protect For Information Operations

OBJECTIVE: The focus of this effort is to develop C2 Protect countermeasures for mobile digitized communications and information networks such as those being deployed to the Army's First Digitized Division (FDD.) The security countermeasures should protect against, detect, and respond to network-based attacks using means in addition to encryption. Specifically, network access control, intrusion detection and response, host level improvements, and security management should be addressed.

The security solutions must be integrated and proven within the bandwidth and connectivity constraints of the Tactical Internet (TI) at all its levels.

Consideration should also be given to C2 Protect countermeasures which help secure connections between the TI and external networks such as Secret Internet Protocol Router Network (SIPRNET) and the Not Classified Internet Protocol Router Network (NIPRNET.)

The Army's TI will be the basic communications infrastructure used in the digital battlefield. Components that comprise the TI are host computers (Applique, Army Tactical Command and Control Systems (ATCCS,) Global Command and Control System-Army,) routers/switches (Internet Controllers (INC,) commercial routers, WIN ATM switches,) radios (Single Channel Ground and Airborne Radio System (SINCGARS,) Enhanced Position Location and Reporting System (EPLRS,) Near Term Digital Radio (NTDR,) High Capacity Line of Sight trunk radios.) Range extension is accomplished through the use of Satellite Communications assets such as Global Broadcast System, Secure Mobile Anti-jam Reliable Tactical Terminal (SMART-T,) and Trojan Spirit.

The security areas within the TI that need to be enhanced are outlined below. It is noted that the TI approach and design itself is going to be changing into a "Next Generation TI," and this topic shall target security solutions that also take in consideration the "new" design.

The Army is implementing intrusion detection within its tactical networks. However, the volume of data is too great to respond to each alarm. The vast majority of the alarms reflect innocuous events rather than intrusions. Work effort is needed to gather data to assist in developing methods to allow the user to analyze the data to recognize/protect against network intrusion. This technology would significantly enhance the Army's ability to identify and respond to intrusions within the tactical environment as well as in garrison.

DESCRIPTION: Network Access Control: Methods of incorporating access control in the following areas should be addressed:

User identification and authentication - candidate areas include secure password generation, biometrics, one-time password techniques, and token based authentication. Security improvements to the router and network management protocols
Cryptographic authentication

Auditing and Intrusion Detection/Response: The inclusion of an intrusion detection capability should be addressed to detect insider and outsider attacks. The Intrusion Detection mechanism should also direct the system administrator's attention to high risk sessions and provide guidance to discern where and when alarms must be initiated to indicate intrusion.

Effective automated and human response mechanisms should also be addressed, to include reacting to intrusions, alerting system administrators and users, identifying and possibly eliminating attackers, and performing damage assessment and repair. In addition, the response mechanism should inform the commander of the consequences and impact of a particular response.

Host Protection Devices: Improvements to the host systems residing on the TI to include both Applique and ATTCS hosts should be addressed, specifically in the areas of C2 Protect tools and malicious code detection and eradication mechanisms.

Security Management: Investigate the development of management tools that allow the enforcement of a designated security policy amongst the various prevent, detect and response mechanisms. Identify interrelationships and interdependencies among the C2 Protect components. Develop ways to dynamically enforce new security policies due to changing user roles, operational requirements, or security modes. Develop a firewall component that allows for the definition of a firewall policy that can remotely configure and manage the firewall products identified on the Army approved products list. Extend the features of a network-mapping tool to accept and display Intrusion Detection System, firewall and any other security alerts so as to provide a mechanism to view and assess all alerts.

Analysis of Intrusion Detection Data: Investigate/develop methods to assist the user with analyzing data to recognize/protect against network intrusions, and thereby to significantly enhance ability to identify and respond to intrusions.

Notes:

The DUAP BAA C2 Protect topic has priority over the same topic under the existing CECOM Space & Terrestrial Communications Directorate BAA. Proposals submitted for the latter BAA will not be considered until the DUAP proposal submittal and evaluation period has ended.

It is recommended that the POC below be contacted and that white papers be submitted prior to submitting a formal proposal.

Teaming with commercial technology houses and companies who do not traditionally compete for Government contracts is strongly encouraged.

Descriptions of most of the military components listed above are described in the C4IEWS FY98 Project Book, which may be found at www.monmouth.army.mil, under the topic "Team C4IEWS 1998 Project Book," category "PEO C3S."

CECOM STCD has evaluated many COTS/GOTS C2 Protect tools in several categories described above, for potential use in the Applique/INC/EPLRS/SINCGARS portion of the Tactical Internet. Similar evaluations are currently taking place for the Army Battle Command System (ABCS.) If the proposal will address some of the capabilities found in COTS/GOTS, it is recommended that the proposal describe what additional benefits to existing COTS/GOTS will be provided, and why it is worthwhile for the Army to pursue versus buying existing COTS/GOTS.

It is recommended that prospective contractors target one or a subset of specific areas in the paragraphs above, and not attempt to address many or all of the DUAP paragraphs.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$10,600K

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TITLE: Cellular Telephone/Radio Location

OBJECTIVE: Develop and mature technology, which will determine the location of both commercial and military cellular telephone/radio users. The cellular telephone industry has a FCC mandate to implement an Enhanced 911 capability that provides emergency station operators with position coordinates to the accuracy of 125m (67%). Most severe of the requirements include operation in urban canyons and inside buildings. Solutions may include integration of ground based RF ranging systems, GPS and/or other satellite systems as well as non-cooperative solutions which detect and locate the cell phone user based on signal emission characteristics. All techniques must overcome the challenge posed by multipath, path loss and signal blockage. Industry has already begun to demonstrate enabling technologies that have the potential overcome these challenges.

DESCRIPTION: Under this Dual Use S&T topic, the government will leverage the commercial technology being developed in support of this FCC mandate for technology transition to military/non-military government functions, e.g. situation awareness, prisoner tracking, search and rescue, the Intelligent Vehicle Highway System (IVHS) and endangered animal monitoring. GPS solutions will require the conversion of GPS C/A code systems to a P/Y code capable system to support military requirements. The P/Y code magnitude higher chipping rate versus C/A poses further technical challenges. Of great interest is the ability to conserve power by computing positions instantly, in the set or at the base, and turn to the off/standby mode versus maintaining constant track of an external reference.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTIONS: \$600K

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TITLE: Cooperative Data Harvesting, A.K.A. ‘Combine’

OBJECTIVE: Develop **intelligent agent software** to automate complex data recovery research requirements in a cooperative corporate intranet communications environment. Evaluate new strategies, techniques and procedures for data harvesting using developed intelligent agent software.

DESCRIPTION: Data harvesting within cooperative corporate Intranet communications environments is an important element in future computing settings. Strategies, techniques, procedures and software shall be developed such that corporations, companies, and business units large and small that have little or no dedicated data research capabilities or resources can automate complex research requirements; thus, realizing a savings of time and money. For example, consider a corporate Intranet with the following characteristics:
a high degree of connectivity using modern, scalable networking components
large amounts of widely distributed data that resides on magnetic media and other data storage media belonging to or accessible by the corporation or business unit

Few or no personnel are available and trained in data mining and information retrieval, synthesis and reporting.

A need to separate the “wheat from the chaff” (the information from the data)
It is widely held that friendly intelligent software agents can be designed to harvest required data and assist in automating data mining tasks. Intelligent software agents operate autonomously, seek to accomplish user-specified goals, and react to their environment, sensing changes and responding appropriately. Some intelligent agents also socially interact with other agents for safe passage through security features and other virtual barriers. Intelligent agents can learn or adapt behaviors based upon accumulated experience. Intelligent agents are mobile and can move to different hosts as required or desired. Intelligent software agents can facilitate the accomplishment of value added tasks such as information acquisition, information protection, information processing, information transport, information management, and information denial. Additionally, intelligent software agents can ensure identification and authentication between data owners and inter-agents that may be acting on behalf of other networked components and activities. Further, intelligent software agents can authenticate host environments before processing, and allow the host to authenticate the agent before releasing data to the agent. Research and Development requirements include:

- Generic carrier agents that work within well defined bounding .
- A mechanism to program and reprogram instructions to the generic carrier agents.
- Techniques and automated procedures that give generic software agents specific personalities, mission or missions, a time to live, phone home instructions, breadcrumb trails and other desirable behaviors.
- An analogy to the desired personalities and behaviors of human intelligence agents, both overt and covert, is very appropriate.

TOTAL FUNDING FROM GOVERNMENT AND INDUSTRY: \$5M OVER THREE YEARS

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TITLE: Dynamic Addressing

OBJECTIVE: The basic idea is to define a high level architecture and protocol design to support dynamic addressing in military operations. It is well known that IP addresses are essentially static in nature and that mobility management, configuration, and reconfiguration relies on changing addresses or encapsulation techniques to achieve support for mobile nodes and reconstructed networks of nodes. In addition, the current solution requires a fairly heavy packet exchange load to accomplish this task. The emerging IETF solutions are focused on fixed infrastructure, knowledgeable sysadmin support by knowledgeable technical people, globally known IP addresses and high bandwidth connectivity. The solution for the Army must operate without fixed infrastructure, without sysadmin specialists, and narrow band radio connectivity.

DESCRIPTION: It is well known that the commercial wireless area is growing at a rapid rate. Although dominated by voice at the current time, the data segment of wireless is also expected to increase. There will be a commercial demand for efficient IP like addressing schemes that support mobile addressing and network/node reconfiguration in a more direct and efficient manner. The dynamic addressing schemes should provide interoperability with the existing IPO addressing schemes, but be augmented to have additional functionality for mobile nodes.

A first year will define a high level architecture as well as high level protocol design. It is anticipated that this effort will rely heavily on the current ongoing work in the commercial sector as well as the IETF community. At the end of year 1, the design will be translated into detail software designs and initial prototyping. Year 2 will continue development of the prototype and possibly add additional features to the design. In year 3, the prototype implementation will be completed and demonstrated in a lab environment.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: INCLUDES CERDEC AND DUS&T PROGRAM COST SHARE. \$1,500K

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SUBMIT PROPOSALS TO:
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CONTRACT OFFICER:
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TITLE: Enhanced Terrestrial PCs Technology for Tactical Applications

OBJECTIVE: The objective of this effort is to enhance commercial CDMA cellular systems, currently being adapted to tactical applications, to provide system elements that safeguard against identified inherent system vulnerabilities. These developments may be exploited in both tactical and commercial applications. Development in this area can be targeted to protecting user sensitive information that would enhance subscriber anonymity and privacy. Another area of interest is resolution of potential “spoofing” techniques. One method of improving system vulnerabilities is to foster the development of a GSM-CDMA interface which has the potential to include GSM system features that protect subscriber information and to maintain the advantages of having the CDMA Air Interface. Development in this area would also greatly increase joint interoperability with NATO countries such as the UK.

DESCRIPTION: Incorporation of Terrestrial PCS technology within the tactical battlefield would greatly enhance subscriber mobility and set-up. Utilization of CDMA technology is the preferred digital technology as CDMA reduces frequency management and offers greater capacity. A limitation of this technology is inherent system vulnerabilities that this program will address. Development of solutions to solve these vulnerabilities would enhance the utility of these systems in the battlefield.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$1,600K

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TITLE: SMART Antenna Applications for Army Airborne Reconnaissance Systems

OBJECTIVE: Current communication systems use low power complex modulations that utilize the frequency spectrum in a very efficient manner. In particular, cellular and PCS systems utilize various methods such as spatial filtering and sectorization to maximize the use of the frequency spectrum. The objective of this Dual-application program would be to develop "smart" antennas that consist of directional antenna arrays that are controlled by sophisticated digital signal processing (DSP) algorithms. The algorithms will maximize the gain pattern of the antenna array to maximize the performance of the antenna array and improve the SNR at the array output. The objective of the antenna array will be to pick up the low power signals amongst various interference signals from a wide variety of platforms, including airborne platforms.

DESCRIPTION: The development and availability of smart antennas will benefit both the military and commercial sectors by improving the quality and capabilities of PCS/cellular systems and Army airborne reconnaissance systems. The SMART antenna will process the desired signal while filtering out interfering signals such as thermal noise, multi-path, and co-channel interference. The end result would be an improved signal to noise ratio which would improve the sensitivity of the receiver systems. Both basic classes of smart antennas should be explored which includes switched beam and adaptive array antennas. The development of powerful digital signal processing algorithms will be critical the SMART antenna and will need to handle frequency across the communications spectrum and be able to single out individual channels.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$1,000K

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TITLE: Universal PCS/MSS Handset

OBJECTIVE: Develop and evaluate multi-mode Personal Communications Systems (PCS) handsets to facilitate the objective of one common handset for all user applications. The handset needs to be programmable to allow for the integration of current and future third party waveforms and protocols. The handset architecture requires the flexibility to add security encryption features. Future requirements will also include multiple frequency band operation for worldwide use. This vision, of one common handset is shared by the Army and commercial industry and fits with the concept, one phone wherever you go.

DESCRIPTION: The Army vision for handheld voice Personal Communications Systems (PCS) revolves around a single handset. This handset would allow the user to access all available terrestrially based PCS systems, local wireless loop systems (for building applications), satellite PCS systems, and peer-to-peer communications when there is no infrastructure present. The near term emerging PCS/Mobile Satellite Service (MSS) handsets allow the user to achieve only part of this vision. Additional waveforms and protocols are required to meet all the Army wireless handset voice needs.

This effort expands upon current commercial initiatives in this area and will allow the evaluation of current handset technology to handle multiple waveforms. This effort will develop and evaluate the technologies required to provide this single, common handset. As part of this effort a prototype testbed handset will be developed for testing and analysis. This goal will be achieved by developing a handset that will allow the addition of third party waveforms. An evaluation of the addition of current and emerging PCS and Peer-to-Peer waveforms will determine an acceptable path toward the common handset. The software implementation of additional waveforms on these handsets will be the first step in moving toward the Army's ultimate vision, one common handset.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$1,000K

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TITLE – Universal Turbo Codec

OBJECTIVE: Proposals are being solicited for the development of a flexible Turbo Code codec engine that is applicable to various channels including satellite, wireless, and fiber. The implementation desired is one with adaptable parameters to suit the media constraints for the radio of interest.

DESCRIPTION: Increased demands for satellite communications using smaller manpack platforms and higher data rates requires more efficient schemes to close the links. Terrestrial radios are faced with similar challenges over fading channels. This demand may be met through use of a novel coding technique known as Turbo Coding which may offer approximately 3 dB improvement over conventional methods. The performance parameters of interest are: end-to-end bit error rates, constraining delay (60ms additional one-way), data throughput, design complexity, battery consumption, and performance in burst error and fading channel conditions. Turbo Coding research is ongoing primarily in modeling and simulation and the Army has obtained some encouraging results. A flexible design hosted on a programmable platform such as FPGA is key to allow algorithm modifications if needed. Will need to test and demonstrate Turbo codec performance over a SATCOM channel and terrestrial wireless channel to characterize BER, delay, data throughput, and burst error performance. Compare performance and implementation complexity against conventional Viterbi decoder. The codec engine produced could be marketed for both military and commercial applications. Military UHF and EHF SATCOM terminals (SPITFIRE, SCAMP, and SMART-T) as well as terrestrial radios (SINCGARS, NTDR, JTRS) could benefit from such an upgrade. Similarly, commercial PCS handsets that require miniaturization and reduced power operations would also be likely platforms. Emphasis on a cost effective, programmable implementation of the technology is key for it to be marketable across many platforms. An actual implementation that is flexible will help speed this technology for use in both military and commercial applications. Desired performance is up to 8 MBps throughput with $BER=10^{-8}$ at 2dB E_b/N_o with minimum battery consumption that performs well over satellite and wireless channels.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$400K

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TITLE: Metadata Tools for C2, DoD, and Dual-Use Applications

OBJECTIVE: Develop tools and technologies for metadata creation, management, and use for Command and Control (C2), DOD, and Dual-Use Applications, based on emerging metadata standards. Specific deliverables, in rough Army priority order, could include:

Authoring tools for tagging content with metadata, either manually, automatically, or semi-automatically, for use on new and legacy content.

Metadata servers to respond to authorized queries. Could include user capability to obtain and prove such authorization.

Metadata search language/tools, to enable a user to efficiently describe what should be searched for. Could include agents and user profiling.

Robust repository tools and systems to enable large enterprises, such as DOD, to create, manage, and evolve metadata repositories

This list is provided as a rough guide. Offerors should propose what they believe are the next key products needed by both the Army and commercial customers, based on advances in technology, the Web, and various standards bodies such as W3C, IEEE, NCITS, etc. Offerors are not expected to deliver all of the above, and are encouraged to propose other key items they believe are ready for productization.

DESCRIPTION: Metadata is information about an object, be it physical or digital. The combination of the Information Revolution and the World Wide Web has resulted in an explosion of available information, but no way to intelligently search through it beyond basic key-word matching. Mr. Tim Berners-Lee, recognized father of the Web, has stated, "Metadata [is the] key to moving [the] Web from chaos to quality." Ms. Dawn Hartley, DII COE Chief Engineer, has called for a DOD-wide metadata solution. Emerging standards are now providing a blueprint for implementation, but various tools and technologies will still be needed to manually author, automatically generate, and manage multiple and evolving repositories of this metadata. Commercial markets for the above products and services will exist in any field with large amounts of data that need to be found and used, including education, corporate training, medicine, finance, corporate intranets, etc. It is expected that functioning products will be delivered to both the Army and commercial customers and that the offeror will continue to improve the commercial products after contract completion. The Army will have the right to purchase these improved follow-on products at commercial prices.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$400K

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TOPIC: Quality Of Service for IP Technology

OBJECTIVE: Desktop teleconferencing development has taken two distinct paths. One path is “data-centric” that emphasizes data sharing and white boarding best associated with narrowband ISDN (N-ISDN) and guaranteed quality of service (QOS). The other is “video-centric” concentrating on inexpensive transmission of IP-based voice and IP-based video data of “acceptable” quality currently supporting non-guaranteed QOS. There is the family of open standards known as the ITU-T Recommendations T.12X supporting multipoint data conferencing. The T.12X family attributes are “seamless” multipoint data delivery supporting concurrent viewing, sharing, modifying, and exchanging of data files. The fact that the T.12X family permits interoperability means that applications from several vendors can work together. The T.12X family also permits error free data and multicast-enabled delivery of data to a select sub-group of participants that is network independent, supports varied topologies, scalable, and coexists with other network standards.

Delivery of standardized data flow, associated with integrated voice, data and video, is best be defined by the family of ITU-T Recommendations H.32X whether “data- or video-centric”. The next logical advance in desktop conferencing technology is to extent guaranteed QOS to standardized data flow supported by local area networks. Two of these standards are ITU-T Recommendation H.322 and ITU-T Recommendation H.323 supporting multimedia applications over local area networks (LANs). ITU-T Recommendation H.322 supports guaranteed QOS but is currently underutilized. ITU-T Recommendation H.323 provides non-guaranteed QOS with wide use in the government and industry.

DESCRIPTION: The focus of this proposed effort is to explore ways to achieve the required, guaranteed QOS, associated with real-time, IP-based, multimedia communications over tactical and commercial, asynchronous transfer mode (ATM) backbone networks. Specifically, investigate and develop technology capable of guaranteed QOS LAN support to IP-based voice, data and video flows that meet the family of ITU-T Recommendations H.32X/T.12X. The issue of guaranteed QOS for ATM network support of integrated IP-based, voice, data and video over LAN also requires addressing for tactical and commercial, multimedia communication, operating over a point-to-point, point-to-multipoint, and multipoint-to-multipoint ATM connection(s). The proposed program will, therefore, explore and develop techniques in light of the LAN support to the new efficient, compressed, voice and multimedia encoding techniques existing or under development by the government and industry.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$400K

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TITLE: Information Technologies for Simulation-Based Acquisition

OBJECTIVE: Develop commercially supported information infrastructure technologies to enable implementation of the Simulation-Based Acquisition policy being brought forward by the Office of the Secretary of Defense. Application of simulation-based acquisition is essential to maintaining U.S. military strength across all services in the face of reduced defense budgets. Primary goals are to develop technologies and products to enhance interaction and streamline technical/cost review between the services and their system contractors, and to manage product information/data over the product development/support life cycle. Information technology products and capabilities developed will have broad applicability across the commercial sector, particularly in manufacturing (e.g., automotive), and in long-lifecycle fleet acquisition and operations support (e.g., commercial air transport, commercial shipping and shipbuilding).

DESCRIPTION: Development, maturation, and commercialization of information technologies for simulation-based acquisition will enable all services to maintain superiority in systems and equipment under reduced defense budgets. Key opportunities exist to reduce system acquisition costs through:

- (1) Product Modeling to unify system requirements, product data, performance/cost prediction models, and field information,
- (2) Data Management to maintain product models and related system information across the product development/support lifecycle,
- (3) Collaborative technologies to enable live interaction of the user, engineering, and support enterprise while accessing the product model and other analysis resources. Successful proposals in this topic area will develop and integrate information infrastructure products that will fill gaps that currently exist in commercial offerings. Proposed solutions should support heterogeneous core applications (i.e., CAD/CAM/CAE applications, Product Data Managers), span multiple life cycle phases (preliminary design, detailed design, production, field support), and support a geographically-distributed enterprise.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$9,000K

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TITLE: Internet Attack Simulator

OBJECTIVE: The objective of this proposed program is to develop a capability for simulating attacks that are likely to be encountered against networks based on commercial Internet technology. This will support test and evaluation of protection schemes designed to ensure the integrity of the network. When integrated in a distributed simulation environment, using the High-Level Architecture (HLA), the capability will support man-in-the-loop virtual simulation experimentation supporting training and development of Tactics, Techniques, and Procedures (TTP) in a hostile C3 environment. Government advocates for this effort would include DISC4, CECOM, DARPA, TRADOC (Signal Center) and DISA. Many security concerns of internet use have surfaced in the commercial sector as well. The financial, banking, securities, and medical as well as other industries have reported incidents of malicious attacks on information infrastructures based on internet technologies. The benefits of information security techniques developed to support military information systems could be directly realized by commercial industry. The attack simulator will provide a means of testing and certifying commercial information systems.

DESCRIPTION: As the Army moves towards the digitization of the battlefield, a key component of the systems architecture will be the Tactical Internet. The Tactical Internet is composed of many communications components that provide the communications infrastructure to pass digital voice, data and imagery around the battlefield. Each of these components (radios, routers, switches, gateways, and terminals) is susceptible to intrusion with the intent to disrupt battlefield operations. The Internet has changed the way information is transferred throughout the world. As a technology, though, it is still relatively immature. As such, and because of the confidential and secure requirements of the data being transmitted over the Internet, it has become a point of security vulnerabilities for both commercial and military interests. As internet technology matures, the security aspects of information protection for both military and commercial utilization of this technology will need to grow along with it. Technologies developed as part of this program will be useful in identifying, analyzing and defining approaches to secure and protect information and the Internet infrastructure. The successful offerer will maintain licensing rights to software developed under the program and will grant site licenses to the Government. Under this agreement, the Government will have the right to modify the software to include classified attack data.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$300K

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MEDICAL AND BIOENGINEERING TECHNOLOGIES

TITLE: Combat Casualty Care Research

OBJECTIVE: Key technical objectives of the Combat Casualty Care Research program are to provide integrated capabilities for far-forward medical care thereby reducing mortality and morbidity associated with major battlefield wounds and injuries. The goals of the Research and Development effort are to: extend the "Golden Hour" for treatment, in order to improve survival and minimize morbidity after life-threatening injuries; and to provide military medical capabilities for far-forward medical or surgical care of battle and non-battle injuries.

DESCRIPTION: A primary emphasis of the Research Program is the identification and development of medical techniques and materiel (medical devices, drugs, and biologics) for early intervention in life-threatening battle injuries. A premium is placed on medical interventions that can be used within the battle area or as close to it as possible, before or during medical evacuation, preferably by medical corpsmen. Research efforts are needed in principles, and technologies available to render self-aid and buddy-aid; enhancements in techniques, methods, or materials for basic and advanced life support for severely injured persons; management, sustainment and monitoring of severely injured casualties during episodes of delayed or protracted evacuation, management of patients when treatment is delayed as a result of temporary overloading of battlefield facilities; and enhanced management of triage of large numbers of patients and comprehensive and staged treatment at field hospitals. The following areas are of key interest:

1. Methods of minimizing blood loss and optimizing fluid resuscitation, and
2. Treatments to Prevent Secondary Damage After Hemorrhage or Major Injuries; secondary injury mechanisms that occur subsequent to hemorrhage and other major trauma contribute to organ failure, sepsis, and death.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$1200K

POINTS OF CONTACT:

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TITLE: Vaccines and Drugs to Prevent Militarily Relevant Infectious Diseases of Endemic Origin

OBJECTIVE: Develop vaccines and/or drugs for the prevention of militarily relevant infectious diseases which inflict morbidity and mortality upon deployed US military forces when deployed in regions with endemic infectious disease threats. Reducing the impact of endemic infectious diseases on unit readiness and performance is a high priority for all US military services. Priority research issues include:

- 1) Development of novel pharmaceuticals and immunogens;
- 2) Sequencing and functional characterization of the genomes of relevant pathogens to identify drug and vaccine targets;
- 3) Development of novel methods of vaccine and pharmaceutical production;
- 4) Development of novel methods of delivery and administration of vaccines,
- 5) Novel systems for individual and unit protection from infectious disease vectors and
- 6) Novel systems for rapid clinical diagnosis and detection of infectious disease pathogens in far-forward field locations. All products developed within the program are compliant with existing guidelines and requirements of the US Food and Drug Administration and are licensed accordingly. Current diseases of interest include malaria, enteric bacterial diseases (enterotoxigenic *E. coli* [ETEC], shigella and campylobacter), dengue, hantavirus, hemorrhagic fevers, leishmania, hepatitis, Group B meningococcal disease, rickettsial diseases, and HIV.

DESCRIPTION: The development, testing and deployment of advanced, licensed vaccines or pharmaceuticals to mitigate the impact of endemic infectious diseases on force readiness and performance will benefit both the military and the commercial sectors by enhancing personal wellness of military service members and civilian travelers, thereby optimizing readiness and performance. Key technologies emphasized are:

- 1) Genetic sequencing of relevant pathogens and correlation with organism metabolism or organism immunogenesis;
 - 2) Silicon-based DNA and RNA microarrays (gene-chips);
 - 3) Recombinant protein and DNA vaccines;
 - 4) Combinatorial and structure-based chemistry for drug discovery; and
 - 5) Trans-dermal vaccines for easier delivery and enhanced immune response.
- Successful proposals in this topic area will develop vaccines or pharmaceuticals which substantially enhance individual protection from endemic infectious disease and which demonstrate significant advancement in ease of administration.

ESTIMATED POTENTIAL FEDERAL FUNDING CONTRIBUTION: \$4,500K

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TITLE: Pharmacological Strategies to Improve Military Operational Readiness

OBJECTIVE: Demonstrate efficacy of novel drug interventions in applications which will contribute to improved military medical readiness. The application must be a directly relevant research priority in the Military Operational Medicine Research Program. Examples of such priorities are drugs which help soldiers to adopt healthier lifestyle and meet military body fat standards such as a fat “antabuse” drug, and drugs which help to enhance alertness without the adverse effects of amphetamines for emergency use by soldiers operating around the clock in sustained operations. The studies to be conducted will be used to gain FDA approval for these secondary indications.

DESCRIPTION: The development of cost effective approaches to provide assistance to Service members in weight management enhances military medical readiness by reducing the prevalence of obesity which is epidemic in the United States; approximately 2,000 soldiers are eliminated from the Army for failure to meet weight control standards even though many of these soldiers have tried to achieve the standards. Currently, there is no drug approved for weight loss assistance to individuals in the range of overweight expected in military members (body mass index < 27 or 28 kg/m^2) and without comorbidity. This requires a carefully controlled efficacy study, preferably with a real soldier population, to demonstrate a lasting benefit from a limited drug intervention combined with a comprehensive weight loss program. Such intervention may require concurrent treatment of family members. The study should measure health and performance endpoints to demonstrate specific benefits and lack of adverse effects, in addition to demonstration of weight loss and continued post loss maintenance. In the second example, emergency aids to maintain performance during sustained operations missions are critical to Army aviators and other specialized performers where lapses in mental performance may be catastrophic. During Operation Desert Storm, amphetamine use in such critical aviator jobs was approved on a limited emergency basis. While amphetamines and other vigilance-enhancing drugs have been demonstrated to be efficacious and, on a limited use basis, have relatively few side effects, new drugs approved for narcolepsy such as modafinil may be equally useful with fewer side effects. Controlled studies in militarily-realistic models, simulators, and actual flights must be conducted to demonstrate usefulness to the Army and to gain FDA approval for a secondary indication for a drug application which will have to consider the risk-benefit tradeoff of critical performance sustainment instead of amelioration of an illness.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$1,000K

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TITLE: Diagnostics, Prophylactics and Therapeutics for Use with Militarily Relevant Diseases Caused by Potential Biological Warfare (BW) Agents

OBJECTIVE: Develop diagnostic tests to identify potential BW agents under presumed battlefield conditions of limited time, electrical power, supplies and personnel. Develop vaccines and/or drugs for the prevention of diseases that are caused by BW agents. Deployed US military forces face the threat of exposure to BW attack. Reducing the impact of the exposure on unit readiness and performance is a high priority for US military services. Priority research issues include rapid and battlefield-forward agent identification; development of novel pharmaceuticals and immunogens; efforts to sequence genomes of agents of interest and correlate with agent's metabolism and/or immunogenesis; novel methods of vaccine, antitoxin and pharmaceutical production; and novel methods of delivery and administration. All products developed within the program are compliant with existing guidelines and requirements of the US Food and Drug Administration and are licensed accordingly. Current diseases of interest include anthrax, ricin intoxication, *Staph. aureus* enterotoxin exposure, brucellosis, plague, viral encephalitides, glanders, and others.

DESCRIPTION: The development, testing and deployment of advanced diagnostic devices and advanced, licensed vaccines or pharmaceuticals to mitigate the impact of pathogenic agent exposure on force readiness and performance will benefit the military sector by enhancing personal wellness of military service members. The commercial sector will experience enhanced civilian health care through the use of these advanced products both in the clinic/hospital setting and in the area of domestic preparedness for possible terrorist attacks. Key areas emphasized are:

1. Rapid and simple diagnostic systems for multiple agents,
2. Advanced vaccines for one or more BW agents, and
3. Advanced treatment to mitigate effects of agent exposure. Successful proposals in this topic area will develop diagnostic systems, vaccines or treatments that substantially enhance individual protection from BW agents and/or demonstrate significant advancement in ease of administration.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$2,700K

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TITLE: Detection, Pre-Treatments and Therapeutics for Use with Militarily Relevant Injuries Caused by Potential Chemical Warfare (CW) Agents

OBJECTIVE: Develop detection systems to identify potential CW agents under presumed battlefield conditions of limited time, electrical power, supplies and personnel. Develop pre-treatments and/or drugs for the prevention of injuries that are caused by CW agents. Deployed US military forces face the threat of exposure to CW attack. Reducing the impact of the exposure on unit readiness and performance is a high priority for US military services. Priority research issues include rapid and battlefield-forward agent identification; development of novel therapeutics for use before or after exposure; novel methods of pharmaceutical production; and novel methods of delivery and administration. All products developed within the program are compliant with existing guidelines and requirements of the US Food and Drug Administration and are licensed accordingly. Current CW agents of interest include nerve agents, vesicant agents, pulmonary agents, blood agents and others.

DESCRIPTION: The development, testing and deployment of advanced detection devices and advanced, licensed pharmaceuticals to mitigate the impact of CW agent exposure on force readiness and performance will benefit the military sector by enhancing personal wellness of military service members. The commercial sector will experience enhanced civilian health care through the use of these advanced products both in the clinic/hospital setting and in the area of domestic preparedness for possible terrorist attacks. Key areas emphasized are:

1. Rapid and simple detection systems for multiple agents,
2. Advanced pharmaceuticals for one or more CW agents, and
3. Advanced pre- or post-treatment to mitigate effects of agent exposure. Successful proposals in this topic area will develop detection systems or treatments that substantially enhance individual protection from CW agents and/or demonstrate significant advancement in ease of administration.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$2,000K

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TITLE: Telemedicine and Advanced Medical Technologies

OBJECTIVE: Key technical objectives of the telemedicine program are to demonstrate capabilities for: real-time monitoring and assessment of the health status of warfighters and warfighting units; remote triage of injured personnel; reporting of individual/unit status to medical and operational personnel; realistic simulations for training of medical personnel; and medical decision support for medical personnel.

DESCRIPTION: Medical/surgical simulations utilizing haptic feedback-supported virtual reality are needed to facilitate training of medical corpsmen, physician's assistants and surgeons in battlefield-related medical procedures. Noninvasive sensors are needed that can measure key physiologic parameters and thereby allow computers to diagnose wounded patients and assist in triage and treatment. Of special interest is a non-invasive sensor that can accurately determine arterial oxygen saturation. This device must function with good accuracy under conditions of low blood pressure (down to mean arterial pressures of 40 mm Hg) and in circumstances where carbon monoxide levels are elevated. The measurement update rate should be rapid to allow for dynamic tracking of changes (at least once every 5 sec). This device must be lightweight, with low power requirements and be ruggedized to withstand the rigors of military and civilian field use.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$748K

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WEAPONS SYSTEMS SUSTAINMENT

TITLE: Advanced Nonthermal Processing Methods

OBJECTIVE: To optimize and validate, in collaboration with food industry and academic contractors, advanced nonthermal processing methods, such as high pressure preservation (HPP) and pulsed electric field (PEF) processing that will ensure the safety and nutritional value of fresh and freshlike preserved foods for consumption by warfighters in combat scenarios. Research and development will be done in conjunction with food industry partners to assure a production base able to meet the flexibility in military logistics demanded by the 21st Century battlespace. The effort will collect data to further regulatory approval of these new food processing technologies for both acid and low-acid foods. A combination preservation strategy may be employed to control the outgrowth of bacterial spores. Process validation and optimization will involve collection and analysis of data on process effects on pathogenic microorganisms, content of labile nutrients of special interest to the military and nutraceutical foods industry and consumer acceptance with attention also to process economics, engineering and scale-up issues. Some effort will be directed to establishing model Good Manufacturing Practices and guidelines for establishing processing authorities for the new technology. *A two or three-year effort for each selected technology is anticipated.*

DESCRIPTION: The services require logistically tailored, nutritionally enhanced rations to sustain performance of individual warfighters in projected forces in a wide variety of environments. The major goals are to increase operational readiness and fighting efficiency through advanced nutritional support to enhance physical performance and mental acuity. The new nonthermal pasteurization methods offer high potential for microbiological control while minimizing the chemical changes brought about by classical thermal preservation methods, which may compromise some of the more labile bioactive nutrients in foods. Provision of fresh fruits and vegetables and dairy items to field units will benefit both morale and nutritional status of the warfighters. It is critical for DoD to take the lead in encouraging and facilitating industrial efforts to acquire regulatory approval of such methods; the DoD has been recognized to play a lead role in implementation of advanced food processing technologies in the interagency response to the President's Food Safety Initiative.

ESTIMATED MAXIMUM GOVERNMENT FUNDING CONTRIBUTION:
\$250K/YR (HPP) \$330K/YR (PEF), THREE YEAR TOTALS: \$750 K (HPP)
\$990 K (PEF), THREE YEAR GRAND TOTAL: \$1740 K

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TITLE: Advanced Thermal Processing Methods

OBJECTIVE: Explore, optimize and validate, in collaboration with food industry and academic contractors, advanced thermal processing methods that would provide high quality foods with utmost convenience for consumption by combat forces in the field. By taking best advantage of a high-temperature short-time process, sensory and nutritional attributes of freshly prepared foods can be retained while the product is rendered shelf stable. Using either aseptic post-processing packaging or pre-packaged methods, the products are packaged in environmentally friendly and lightweight polymeric containers that are easy to open and logistically efficient. A combination of several such methods can further increase the throughput of the products and reduce the processing cost, and most important, produce foods with the highest quality and nutritional value for heat-and-serve use. *A three year effort is anticipated.*

DESCRIPTION: The services require logistically tailored heat-and-serve rations to sustain projected forces in a wide variety of environments. The major goals are to increase operational readiness and consumption with reduced field wastage to reduce the overall logistics burden for delivery of combat rations. For years, US Army Soldier, Biological and Chemical Command at Natick (Natick) has exploited numerous innovative thermal processing methods to improve the quality of shelf-stable military rations. This effort has included validating the commercial sterility of the products with both microbiological and chemical methods, demonstrating the sensory quality with both consumer and technical panelists, and joining the market potential study with industrial and academic consortia. Natick also acted as a facilitator in assisting industry to acquire regulatory approval of the novel processing methods. Two key methods are ohmic heating and microwave sterilization. In contrast to the conventional low-temperature, long-time retort processing; ohmic heating simultaneously heats fluid and particulates in pumpable foods, while microwave heating heats whole muscle foods from core to the surface. Both methods provide far less heat damage to the food products due to relatively short processing times. These methods can produce new varieties of entree items that are difficult to produce by the conventional methods. At this moment, the demand for such shelf stable, high quality foods is more in the military than in the civilian market due to unique military ration storage requirements. It is critical for DoD to take the lead in encouraging and facilitating industrial efforts to acquire regulatory approval of such methods.

ESTIMATED MAXIMUM GOVERNMENT FUNDING CONTRIBUTION:
\$400K/YR,
TOTAL: \$1200K

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TITLE: Affordability, Quality And Environmental Compliance Of Rotorcraft

OBJECTIVE: Develop technology for improving the processes or products used in the design and manufacturing of rotorcraft parts, subsystems, and total systems in order to make them more affordable with increased quality while complying with any environmental requirements. It is estimated that at least 85% of the technology used to develop rotorcraft is the same ñ be it a commercial or a military vehicle. Proposals must focus on this area of commonality.

DESCRIPTION: Many processes and intermediate products are used in the design and manufacturing of rotorcraft. Technology can be used to reduce the cost of rotorcraft by improving or replacing these existing processes and products. Technology can also be used to enhance the quality of the intermediate and ultimate products. Technology can also be used to reduce or eliminate conflicts between existing/new processes and environmental constraints. Proposals that present innovative, feasible, and affordable concepts to such processes and products are solicited. Examples of technologies which it is envisioned can lead to improved processes and products include integrated design tools development, rapid prototyping fabrication, design optimization, structural efficiency of composite and metallic materials, composite structures, high temperature composite applications, fiber thermoset materials, structural joining technologies, low cost resin transfer molding technology, high speed machining technology, crashworthy structures, crash safety, and life prediction and damage tolerance for composite and metallic materials. Successful proposals in this topic area will develop technologies that can be economically applied to either existing or future rotorcraft.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$ 2,000K

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TITLE: Performance Improvement and Noise Reduction for Rotorcraft

OBJECTIVE: Develop technology that enhances the rotorcraft performance capabilities and reduce the noise radiation. It is estimated that at least 85% of the technology used to develop rotorcraft is the same ñ be it a commercial or a military vehicle. Proposals must focus on this area of commonality.

DESCRIPTION: Rotorcraft have yet to reach their maximum capabilities in terms of efficiency and magnitude of flight performance and also in terms of noise reduction. There are significant opportunities to fly faster, longer ranges, higher payload, and pull more g's with less power, to reduce adverse aerodynamic forces (like drag, interferences, and download) and noise radiation. Proposals that present innovative, feasible, and affordable concepts to reduce these limitations are solicited. Examples of technologies which it is envisioned can lead to enhanced rotorcraft performance and to reduce rotor noise radiation/vibration include aerodynamic efficiency, load and vibration reduction, high figure of merit, aerodynamic interferences, dynamic systems stability, maneuverability/agility, active blade control technology, and smart structures/materials. Successful proposals in this topic area will develop technologies that can be economically applied to either existing or future rotorcraft.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$ 1,000K

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TITLE: Expanded Rotorcraft Operations and Certification/Qualification Harmonization

OBJECTIVE: Develop technology that will expand the operational flight envelope of rotorcraft in terms of being able to fly in all weather conditions and in any type of terrain. Develop technology that will provide new operational capabilities for rotorcraft and open new markets for commercial rotorcraft that can also be applied to new missions for military rotorcraft (or vice versa). Develop technology that can bring the analysis and testing requirements of civil certification and military qualification of rotorcraft into closer harmony. Develop technology that minimizes the need to perform analyses or testing that are unique to civil certification or unique to military qualification or to repeat analyses or testing that are very similar for certification and qualification. It is estimated that at least 85% of the technology used to develop rotorcraft is the same ñ be it a commercial or a military vehicle. Proposals must focus on this area of commonality.

DESCRIPTION: Compared to fixed wing aircraft, rotorcraft are limited in terms of the weather in which they are allowed to operate. Both civilian and military operators have a strong desire to have significantly increased flexibility in terms of the environments in which they can operate safely, or at all. Technology could be used to provide the capability to operate rotorcraft in more severe wind and/or icing conditions, to use them in even more confined areas, or use them in operations never before envisioned. For example, if a rotorcraft had more of a particular mode of maneuverability or agility, there might be an operation that it could then perform which it had never previously been able to do. This situation could open up new markets or missions to rotorcraft. Examples of technologies which it is envisioned can lead to expanded rotorcraft operations include carefree controls, active flight control technology, handling qualities research, all-weather and all-terrain operation, situational awareness technology, HUMS technology, advanced rotorcraft crew systems, reliability, and rotorcraft safety.

The Federal Aviation Administration (FAA) certifies aircraft; the military qualifies aircraft. Currently, there are many situations where certain analyses or testing are required for civil certification while similar (but not identical) analyses or testing are required in the course of military qualification. There is a need to identify and develop technology that will allow analyses or tests to be performed once and then be used as the basis for both certification and qualification. The objective is NOT to write new specifications. Rather, it is to develop the technological basis and justification for using a common or harmonized set of analyses or tests to substantiate that a rotorcraft is suitable to be both certified (by the FAA) and qualified (by the military). Doing so is expected to substantially reduce the cost of performing both a certification and a qualification for a given rotorcraft.

Successful proposals in this topic area will develop technologies that can be economically applied to either existing or future rotorcraft.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$ 1,000K

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TOPIC: Semi-Autonomous/Autonomous Vehicle Operation

OBJECTIVE: The Army has a requirement to increase the force effectiveness of both the tactical and combat vehicle fleet by improving the Army's logistics capability to move personnel, equipment, materiel, and supplies to sustain operations and move the forces which execute those operations. The Army must reduce the number of personnel required to provide logistics support and decreased logistics costs while improving load carrying capability. The Army requires the capability to effectively move resources in a timely manner and keep pace with the supported force.

DESCRIPTION: Proposals in this area should address the use of emerging vehicle electronics for the partial or full automation of vehicle operator tasks. These could include, but are not limited to, intelligent cruise control and leader/follower technologies for convey operations, route planning and position reporting, seamless tracking of assets and cargo, and on-board diagnostics and predictive maintenance. Supporting technologies will likely include machine vision, infrared sensors, radar imaging, global positioning, satellite communications, voice recognition, database management, and expert system/artificial intelligence. The use of affordable vehicle technologies is required to enable fleet implementations, therefore only cost effective solutions will be considered.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$7,500K

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DISTRIBUTED MISSION TRAINING

TITLE: Rapid C2 Data Visualization and Decision Making via War Gaming Technology

OBJECTIVE: Develop a wargame software application that is low cost, has internet collaboration capabilities, and intuitive data visualization user interfaces. This software application will enable the planners of the various battlefield functional areas (e.g., maneuver, fire support, intelligence, logistics, etc.) to perform “what-if” analysis on a map-based scenario. The application will include a large category of decision factors (e.g., weather, line of sight, surprise, technological superiority, fog of war, attrition, etc.) It will be suitable for operational and tactical Army Command and Control (C2) use. Additionally, the automatic alert and queuing models utilized in war gaming applications will be tailored to accurately aid real-world decision planning processes.

DESCRIPTION: The application that will be developed under this dual use proposal is a war game that will replicate intelligence, maneuver, fire support and logistics battlefield functional areas. This war game will provide a Common Operating Picture (COP) simultaneously to at least 50 players of the game. This COP will be shared via TCP/IP communications. This war game will enable multiple decision makers to plan, execute, monitor and rapidly replan battles collaboratively. Real-time dynamic factors, such as changing weather patterns, day/night lighting, and fog of war representation will be demonstrated. Users will be able to tailor visualization (e.g., standard NATO symbology, 2-D/3-D item representation, map scaling and details, etc.) and reporting mechanisms (e.g., audio alerts, items of interest selection, etc.) These capabilities will be utilized in developing a functional Army Command Post C2 system. The commercial version shall cost less than \$55 per software copy in large quantities.

TOTAL ESTIMATED FEDERAL FUNDING CONTRIBUTIONS: \$250K

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TITLE: High Performance Set Operation Generation for Spatial Data Sets

OBJECTIVE: Develop a high performance Boolean set operation capability that achieves order of magnitude performance enhancements over current commercial products. Since set operation generation underlies a wide range of analysis functions from human-oriented visual analysis to fully automated sensor exploitation, situation awareness, and mission planning, such a capability possesses a wide range of both military and commercial applications. The computational efficiency of current commercial products, including those employed by the Joint Mapper Toolkit (JMTK), tend to be inadequate to support certain large-scale, real time applications, such as automated situation awareness development, large scale contingency planning, and mission rehearsal.

DESCRIPTION: Two-dimensional spatial analysis underlies numerous aspects of both human and machine-based reasoning. The ability to associate nearby geographic features, sensor-derived data, weather data, and a priori analysis products are critical to a wide range of applications, including the understanding of earth resource data, tactical and strategic situation awareness, and autonomous navigation systems. The effort will implement a new technical approach to 2-D set operation generation. The technology will use quadtree-indexed representation of vector-based spatial data. As an indication of the potential advantage of a proposed approach, an analysis indicating the computational complexity shall be given. The proposed technique shall provide highly focused, top-down indexing structure, for large regions, the proposed technique should be orders of magnitude more efficient than traditional algorithms. These differences should become even more pronounced when one or both regions contain multiply-embedded holes.

The program will result in an operational demonstration of both set intersection and set union at the end of the period of performance. The demonstration will employ realistic data sets selected by the Government sponsor. Comparative performance on the same data sets using JMTK or similar product will be provided by the Government sponsor. Effective support for real time combination of linguistic terrain descriptors with underlying geo-spatial feature data sets, and past, current, and future weather data will permit robust analysis of sensor-derived data. Such support to context-sensitive analysis has utility to both military and non-military applications. Examples of the former application includes high performance overlay reasoning support to the Army's All Source Analysis Systems (ASAS), as well as CECOM's Automated Map-Based Intelligence Support System (AMBISS).

Important commercial applications for this technology include performance enhancements to commercial database and geographic information systems. Examples of specific commercial application include improvement of remote mineral and oil exploration using commercial satellite and map data, geographic marketing, demographic, and political analysis, and commercial navigation.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTIONS: \$120K

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ADVANCED MATERIALS AND MANUFACTURING

TITLE: Manufacture of Single Crystal Tungsten Alloys

OBJECTIVE: The ability to manufacture bulk single crystals of refractory alloys would address a performance deficiency in several commercial and military applications. In the commercial sector, these materials show extraordinary high temperature creep resistance such that they are the materials of choice for space power thermionic emitter jackets. The need to have long term reliable power systems in space for commercial telecommunications makes these materials especially sought after. In the industrial metrology area, sustaining high power x-ray tubes frequently suffer from material fatigue/creep failure of the electrode. Electrodes of single crystal refractory metals would substantially ameliorate this problem. In the military sector, these materials display unusually good ballistic penetration performance given the appropriate crystallographic orientation. There is therefore substantial Tri-service (Army, Navy, Air Force) interest in evaluating these materials. However, a reliable cost effective manufacturing methodology able to scale up these materials, both in quantity and size, needs to be first demonstrated before these materials can be transitioned into various military and commercial systems.

DESCRIPTION: This topic seeks the development of a manufacturing methodology that can produce oriented single crystal tungsten alloys by a cost effective process to meet the demands of future tri-service weapon systems. Prospective candidates are to demonstrate knowledge in this technical field, provide a technical approach supported by prior work in this area. Partnering with academia and other non-federal organizations is encouraged.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$100K

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TITLE: Nickel Free Tungsten Alloys

OBJECTIVE: The main objective of this two year effort is to find a suitable replacement for nickel as one of the matrix binding materials in tungsten alloy munitions. Nickel is currently used in most heavy metal applications because of its higher melting point, its solubility with tungsten, and its formability. However, it is also on the EPA-17 list of toxic materials whose usage must be eliminated or reduced significantly. This technology will be directly translatable to the private sector, as tungsten/nickel alloys are utilized as vanes and other components in turbine engines, counter weights and golf club heads.

DESCRIPTION: This program shall be performed over a two-year period. This first year of effort shall involve the following:

- Paper search of previous work
- Discussions with academia/experts in the technology
- Computer simulation of alloy systems
- Selection of alternatives
- Preliminary metallurgical assessments
- Physical properties
- Mechanical properties (hardness, tensile strength, fracture toughness)
- Microstructure
- Formability
- In the second year of effort the following shall be accomplished:
- Down select to two alloy systems
- Test vehicle process refinement
- Test vehicle quazi-production evaluation
- Product testing

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$400K

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TITLE: Production Feasibility of Flame Retardant Technologies for Nylon Fiber

OBJECTIVE: Demonstrate production feasibility of novel flame retardant technologies for nylon fibers. The development of a non-melting flame retardant nylon fiber will benefit both the military and commercial sector by providing flame retardancy protection to nylon items that currently do not offer such protection and also by replacing very expensive fibers such as Nomex, Kevlar and PBI, used on tankers, aviators and fire fighter's clothing. In addition, the development of a highly flame retardant nylon fiber will also address the commercial sector needs in the areas of airplanes seats and curtains, hospital and hotel curtains and bed linens, children's sleepwear, fire fighters clothing, car racers, just to mention a few.

DESCRIPTION: Advanced flame retardant materials and innovative flame retardant formulations are currently being developed that will be co-extruded with the nylon polymer to produce a char forming, highly flame retardant nylon fiber that does not melt drip during burning. Nylon fiber is the most widely used fiber in military items. One of the drawbacks of nylon is its burning characteristics. In addition to propagating flame, nylon melts during the burning process causing very deep and severe burns. The essence of this proposal is to form a partnership with the industry to scale-up and demonstrate production capability of the current work being developed under an exploratory development project entitled "Novel Flame Retardant Technologies". This work is being done both at laboratory bench level and pilot scale. To insure proper transition of the technology to commercialization, a need exists to demonstrate fiber production feasibility.

ESTIMATED MAXIMUM GOVERNMENT FUNDING CONTRIBUTION: \$500K

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TITLE: Flame Resistant Polyester

OBJECTIVE: Currently, there is a need for an inexpensive batting material that will provide adequate flame resistance and thermal protection. Much work has been done to develop polyester battings that are thermally efficient however, these battings are not flame resistant. The objective of this program is to develop an inherently FR polyester by incorporating non-halogenated flame retardant additives into polyester's chemical structure and if needed, a small quantity of char former. *A two year effort is anticipated.*

DESCRIPTION: Currently, Trivera polyester is the only FR polyester commercially available and while it does not melt and drip when exposed to a flame, it shrinks away leaving no protection for the soldier. By adding a non-halogenated FR additive into the backbone of polyester the need for large quantities of FR treatments would be eliminated and less toxic gases would be released during burning. The addition of a char former and/or crosslinking would enhance the polyester making it non-burnable and should provide a low cost alternative to Nomex. This technology has wide reaching commercial applications wherever flame resistant textiles are required such as: tents, clothing, sleeping bags, draperies, health institutions and aircraft interiors.

ESTIMATED MAXIMUM GOVERNMENT FUNDING CONTRIBUTION:
\$250K/YR; TOTAL \$500K

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TITLE: Advanced Materials for Military Vehicles

OBJECTIVE: Develop new technologies and increase the efficiency of current technologies that lead to or enable advancing the integration of lightweight materials into vehicle system design (military trucks, classes 1-8). A large amount of fuel consumption is directly associated with a vehicle's weight, replacement of conventional materials with lightweight materials could substantially reduce vehicle mass. Overcoming the challenges that limits the application of advanced materials will result in improved vehicle design and performance.

DESCRIPTION: Investigate innovative approaches and techniques that will contribute to reducing the cost of advanced materials and increasing development of efficient and cost effective manufacturing processes. The Advanced Materials enabling technologies that are of interest includes:

1. Advanced Materials Forming Processes;
2. Optimizing use of virtual prototyping for manufacturing processes, improvement of machining, grinding and heat treating;
3. Joining of dissimilar and similar materials using methods of adhesive bonding, welding and mechanical fastening;
4. Recycling Technologies for in-plant use and during vehicle life cycle;
5. Material allocation for vehicle structural design, non-structural and powertrain components;
6. Application of Corrosion Prevention Technologies. Technologies that are transferable between the commercial sector and the military are highly emphasized; this further reduces vehicle life cycle costs.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$7,500K

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TITLE: Cost-Effective Flexible Manufacturing in Titanium for Ground Vehicle Applications

OBJECTIVE: Improved methods for manufacturing titanium alloy components for Army ground combat vehicles are sought to reduce costs while increasing flexibility through reductions in tooling, material usage and final machining. Current techniques for manufacture of components from wrought titanium products either take large amounts of machining to hog out the part or require fabrication of expensive dies for each individual item to obtain near shape parts. The technology sought in this program would enable the production of near shape parts without wasteful, extensive machining or expensive die manufacture. This technology would be directly applicable to parts manufacture in the automotive, aerospace and medical industries.

DESCRIPTION: Currently, a laser-based free forming process can manufacture complex Titanium shapes without molds or dies producing near shape parts. However, use of this process for production of large components for ground vehicle applications becomes cost prohibitive. In this proposal, a combination of traditional manufacturing and advanced free forming would be developed to produce larger parts at lower cost without sacrificing material properties. The proposal should seek to develop a flexible process that combines traditional Titanium manufacturing methods (e.g. forging, rolling, extrusion) with advanced free forming techniques. Ideal methods would be additive in nature, in order to take advantage of conventional titanium manufacturing methods for the bulk material while selectively adding additional material only where it is required for protrusions such as flanges, bosses or thickened mating surfaces. The process developed should have the flexibility to accommodate parts of various sizes and features. The titanium added through the proposed approach must meet standard mechanical and chemical specifications for the wrought titanium plates, which will require both process and environmental control. Potential military applications include the next generation howitzer (Crusader) vehicle hull plates, doors and hatches, the gun mount assembly, and the track and suspension assemblies.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$250K

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SUBMIT PROPOSALS TO:

U.S. Army TACOM-ARDEC

AMSTA-AR-PC-A, Bldg. 10

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TITLE: Electrospinning Protective Membranes for Military and Civilian Use

OBJECTIVE: Develop electrospun membranes useful for chemical/biological warfare protection for military and civilian use. Incorporate additional membrane properties for multifunctional protection, such as fire resistance, bacterial/fungal resistance, wind resistance and water resistance. Extend the application of such membranes into structures for medical devices and products. *A three year effort is anticipated.*

DESCRIPTION: Protective membranes are under development by the Army for chemical, biological, and environmental protection in clothing systems. The advantages of electrospun membranes are:

1. They are light weight;
2. They are very breathable;
3. They can be designed to be liquid barriers;
4. They are wind barriers;
5. They are easily and directly made into useful layers in clothing and on complex 3D surfaces;
6. Various solid and liquid components can be easily blended into the fibers; and
7. Manufacturing capability all ready exists for commercialization of this technology.

Electrospun membranes can also be incorporated into sport clothing, perhaps even more easily than the current membrane systems. Fiber that is produced by electrospinning is 10-100 times finer than conventional fiber, and can be collected into a continuous web onto fabrics, metal mandrels, and other surfaces. Fine fiber size produces high absorption; the high porosity of the membranes produce highly breathable, light weight films of material; the high surface area of fiber in the membrane has potential for reactivity at membrane surfaces for detoxifying contaminating compounds. These features of electrospun membranes can be incorporated into many different products for both military and civilian use such as elastomeric water proof breathable inner liners for sport and military clothing; bacteriostatic/fungicidal components in disposable clothing and wound dressings for medical use; filtration additive with high surface area for detoxification of waste streams or warfare agents; low volume, high performance, high cost nanofiber component in fibers, textiles, and composites.

ESTIMATED MAXIMUM GOVERNMENT FUNDING CONTRIBUTION:
\$200K/YR, TOTAL: \$600 K

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TITLE: Door Breaching System

OBJECTIVE: Develop a door breaching system that can open doors to buildings from as much as 200 meters standoff and be deployed from small enclosures such as rooms, automobiles etc. It is desired to have the capability to deploy a multitude of lethal or nonlethal munitions from the same device. Civilian law enforcement could use the device to breach homes and businesses that criminals may occupy without having to expose oneself to the door front. Large lethal & nonlethal munitions could be deployed in an urban battleground from small enclosures.

DESCRIPTION: Proposals should address the following areas:

- Capable of being deployed from small confined spaces such as rooms, automobiles, alley ways, etc. Unlimited daily use by the user is desired.
- Must be able to defeat a variety of doors such as standard residential and commercial door fronts.
- System must be man portable with a desired weight less than 15 lbs and 36 inches in length.
- Propulsion technology must be easily adaptable for deployment of other munitions.
- Proposed system should have no or low signature characteristics. It is desired that the user position be concealed during the deployment of the munition.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$300K

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TITLE: Integrated Kitchen for Garrison Cooking

OBJECTIVE: Garrison cooking in the military possesses the same problems which exist in commercial restaurants and institutional kitchens, namely, reducing operating cost, improving cooking performance, and improving space utilization. Much attention has been given to the cooking equipment used in food service. This new equipment is being designed for cooking speed, menu flexibility and efficient use of labor and energy. The total answer to the improvement in the food service kitchen is, however, greater than the individual use of improved equipment. The answer is found in the design and development of a completely new, improved, and totally integrated kitchen. *A two year effort is anticipated.*

DESCRIPTION: In the integrated kitchen, a fluid heater is located remotely from the kitchen and is connected to the kitchen only by a hot fluid supply line and a cold fluid return line. The fluid is used to transport heat to each individual appliance in the kitchen, as opposed to the conventional kitchen where each appliance has its own combustion system and is completely independent. A non-toxic pharmaceutical-grade mineral oil with thermal stability to 640F is available commercially for the integrated kitchen. The oil has been used extensively for industrial food processing and is approved by the FDA for this use. The high thermal stability permits use of the integrated kitchen for all appliances with operating temperatures up to 500F.

A study has shown that the economic and performance advantages accruing from the integrated kitchen concept relative to the conventional kitchen are:

- Reduced Equipment Costs
- Reduced Operating Costs
 - Higher Energy Efficiency (by a factor of 2)
 - Easier Cleaning and Maintenance
 - Reduced Ventilation Requirement
 - Reduced Insurance Cost
- Improved Cooking Performance
 - Accurately Controlled Temperature
 - Uniform Temperature Oven Cooking Surface
 - Fast Recovery
 - Instantaneously Available from Standby Condition
- Efficient Space Utilization
 - Compact Appliances (Small Footprint)
 - Counter Top Installation (Under-counter Storage)
 - Heaters Located Out of Kitchen in Utility Area

This concept has been used successfully in the development of a military field kitchen called the Rapid Deployment Kitchen. Other field kitchens are currently under development. But strength and potential of this concept could be fully realized in a fixed installation garrison kitchen.

**ESTIMATED MAXIMUM GOVERNMENT CONTRIBUTION: ~\$250 K/YR,
TOTAL: \$500K**

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ENVIRONMENTAL TECHNOLOGIES

TITLE: Electrokinetic Phytoreclamation of Strategic Minerals from Abandoned Mine Tailings

OBJECTIVE: Extraction of marginal, subeconomic mineral resources using metal-accumulating plants and innovative soil amendments, has the potential of providing a cost-effective domestic source of key strategic metals required for Army readiness and a partial solution to abandoned hard-rock mine reclamation initiatives underway in the Western United States. Mining recovery from base ores typically leaves 10% - 25% of the in-place resources not recovered from the ground, leaving an accumulation of economically unexploitable low-grade ores in the form of tailings. The project seeks to develop, optimize and evaluate the feasibility of utilizing electrokinetic effects induced in relic mine tailings under an applied electric field to mobilize the desired metals within or into the root zone of selected well-characterized crop species and hyperaccumulate them in the plant biomass for harvest and recovery.

Tungsten, as an example, is a dense, corrosion-resistant metal that when alloyed with other metals or combined with carbon, increases hardness, durability, and resistance to corrosion for the resultant alloy or compound. Because of these desirable properties, industrialized countries consider tungsten essential in the lighting industry to make light bulb filaments, armament/ordnance manufacturing, tungsten carbide abrasives for metal-cutting, and in specialized high-temperature items and alloys for the aerospace industry. Emerging market sectors for upgraded/value-added forms of tungsten-based products include the production of armaments that are less toxic to the environment.

Over the years, because tungsten resources, production, and processing plants are irregularly distributed around the world, tungsten prices have fluctuated to a greater extent than prices for any other widely traded mineral commodity. Continued over-supply in the 1990s by major producing nations, notably China and Russia, has caused worldwide shortfalls in mining and processing capacity. Flooding of the market has caused many domestic tungsten producers to open and close their operations in response to price changes, adding to a legacy of abandoned sites with expansive tungsten tailing stockpiles that are currently considered only of marginal economic interest.

In addition, alternative, low-cost biotreatment technologies are being sought domestically to remediate environmental legacies of past mining operations, due to an increasing number of human health risk exposure scenarios, brought on by increasing residential development and recreational activities proximal to these abandoned sites.

DESCRIPTION: The specific objectives of this project are to:

- Evaluate the efficiency of upward (counter-gravitational) movement of desired metals and water through the soil by the induced electrokinetic phenomena in soil
- Determine the efficiency of metal uptake from the soil by screened and selected metal accumulation plants in conditions where desired metals are electrokinetically transported through the soil
- Perform bench-scale treatability study to evaluate the growth of metal-accumulating plants under an applied electric field in selected tailings and under electrokinetic control of nutrient and contaminant transport in the plant roots (rhizosphere)
- Determine the optimum operating conditions of the Electrokinetic Phytoreclamation process needed for an efficient metal and nutrient disposition to the plants with particular attention to define the parameters important for a pilot-scale field demonstration
- Design, fabricate and conduct in-house testing of a field-capable pilot-scale Electrokinetic Phytoreclamation system.

ESTIMATED MAXIMUM FEDERAL FUNDING CONTRIBUTION: \$100K

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